

OHIO AGRICULTURAL EXPERIMENT STATION

BULLETIN 117

WOOSTER, OHIO, APRIL, 1900

STOMACH WORMS IN SHEEP

The Bulletins of this Station are sent free to all residents of the State who request them.

Persons who desire their address changed should give both old and new address.

All correspondence should be addressed to
EXPERIMENT STATION, WOOSTER, OHIO

COLUMBUS, OHIO
FRED J. HEER, STATE PRINTER
1900

REPRINTED JANUARY, 1918
EXPERIMENT STATION PRESS
WOOSTER, OHIO

1 Ex. Sta. Bul. 117



The Ohio State University
3 6267 01222742 0

ORGANIZATION OF THE

OHIO AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

R. H. WARDER.....	North Bend
J. T. ROBINSON.....	Rockaway
HON. L. M. STRONG.....	Kenton
THE GOVERNOR OF THE STATE {	<i>Ex Officio</i>
THE DIRECTOR OF THE STATION {	

OFFICERS OF THE BOARD

J. T. ROBINSON.....	President
R. H. WARDER.....	Secretary
PERCY A. HINMAN.....	Treasurer

STATION STAFF

CHARLES E. THORNE.....	Wooster.....	Director
WILLIAM J. GREEN.....	"	Horticulturist and Vice-Director
J. FREMONT HICKMAN, M. A. S.	"	Agriculturist
FRANCIS M. WEBSTER, M. S.....	"	Entomologist
AUGUSTINE D. SELBY, B. Sc.....	"	Botanist and Chemist
PERCY A. HINMAN.....	"	Bursar
JOHN W. AMES, B. Sc.....	"	Assistant Chemist
JOHN F. HICKS.....	"	Assistant Botanist
WILMON NEWELL, M. Sc.....	"	Assistant Entomologist
WILLIAM HOLMES.....	"	Foreman of Farm
CHARLES A. PATTON.....	"	Ass't Foreman and Meteorologist
ANNIE B. AYRES.....	"	Mailing Clerk
CARY WELTY.....	"	Mechanic
EDWARD MOHN.....	Strongsville....	Supt. Northeastern Sub-Station
LEWIS SCHULTZ.....	Neapolis.....	Supt. Northwestern Sub-Station

The Bulletins of this Station are issued at irregular intervals. They are paged consecutively, and an index is included with the Annual Report, which constitutes the final number of each yearly volume.

BULLETIN

OF THE

Ohio Agricultural Experiment Station

NUMBER 117

APRIL, 1900

STOMACH WORMS IN SHEEP

BY J. FREMONT HICKMAN

Early in 1898 this Station published a bulletin (No. 91) on the more common parasitic diseases of lambs. Among other parasites treated of in that Bulletin was the stomach worm or Twisted Strongyle (*Strongylus contortus* Rud.).

During the summer of 1896 sheep breeders generally complained of high mortality among their lambs. The prevalent opinion was that the wet season had much to do with the common and widespread trouble, which threatened the depletion of flocks all over the state. Many who had never thought it worth while to give medicine to a lamb were aroused to the point of administering almost any antidote that might be suggested. But in spite of all that was done winter found the shepherds of Ohio with more lambs unfit to cope with the cold than for many a previous season.

The expectation of a normal season in 1897 was the sheep owner's hope. While in respect to climatic conditions that season proved all that could be wished for, the annoying lamb disease did not disappear, and the summer season of 1898 and 1899 brought similar losses to the flockmasters.

The common recurrence of this lamb disease, through a series of seasons, over wide and varying areas, and under widely differing conditions of rainfall and temperature, makes it quite evident that it is not a malady dependent upon meteorological conditions nor upon local depressions or elevations of the pasture grounds, as some have suspected. It has been found on the hilltops and in the valleys. Flocks everywhere within our state seem to have suffered from the inroads made by this disease, whether they fed upon high or low lands. During the first season above mentioned a few of the flockmasters, upon post mortem examinations, discovered that a little worm, found in the abomasum (fourth stomach) was probably the cause of the death of so many lambs. Our flocks at the Experiment Station suffered in common with others, not seriously however,

until the summer months of 1897. During July and August of that year we lost more than thirty per cent. of our lambs. I found some lung worms (*Strongylus filaria* Rud.) and some stomach worms (*S. contortus* Rud.). Though not satisfied that either of these parasites were present in sufficient numbers to cause death, yet I found no other apparent cause. During the summer of 1898 I found the stomach worm so abundant that I no longer doubted the cause of the trouble, nor was I surprised at the frequency with which death occurred in the flock.

The common experience that external parasites more readily attack young sheep or those of a weak constitution from any cause, finds a parallel in the stomach worms. While older sheep are not entirely free they seldom have them in such numbers as to cause serious loss; indeed they are frequently found in mature sheep that are seemingly in most perfect health.

DESCRIPTION¹

This parasite is a slender, thread-like worm, from three-fourths to one inch in length. Sometimes the worms are white in appearance and at others present a reddish color, presumably as they are more or less filled with blood sucked from the mucous membrane of the stomach.² They are found in the fourth stomach and may be few or many. The inexperienced will find some difficulty in locating these worms unless they are very numerous. It is best to turn the contents of the abomasum out, in which case they will be found either in small numbers, or it may be by the hundred—twisted round worms packed together, their heads buried in the mucous membrane, which is thickened and often bloodless in appearance. Occasionally they may be found in clumps or balls.

INFECTION

The life history of the stomach worm is as yet one of the unsolved problems. Henry Stewart, in "The Domestic Sheep" (page 324) states that it passes its whole life in the fourth stomach, the eggs or mature body filled with eggs being ejected with the dung of the old sheep, which are able to resist its effects better than the weaker lambs, and these eggs are taken up with the grass of pasture by the lambs. Leuckart³ reports having seen them grow rapidly in muddy water and after several moultings reach a state of development in which they were capable of being completely perfected in ruminants.

¹For technical description see "Animal Parasites of Sheep," published by the United States Department of Agriculture, or Neumann's "Parasites and Parasitic Diseases of the Domesticated Animals."

²"It attacks the mucous membrane to suck the blood which gives to its intestine a brown color. It is the convolution of the ovarian tubes around this intestine which has given to the species the qualification 'contortus.'" (Railliet.)

³Neumann's "Parasites and Parasitic Diseases of the Domesticated Animals," page 364.

SYMPTOMS

It would be difficult to point out a special, characteristic symptom for this particular form of worms. The animal affected is dull; spends much time lying stretched out; suffers from a depraved appetite; is frequently found eating earth, bedding, sawdust, or rotten wood; lags behind the flock; becomes poor in flesh, sometimes dropsical. The eyes lose their luster; the limbs are sluggish in action; the face and skin show a decided paleness; while the ears show more and more of the drooping tendency. Lambs frequently suffer from attacks of colic, and in the latter stages of the disease are afflicted with diarrhea, generally terminating in death, which is likely to occur in a few days after illness is first observed. If the animal does not succumb to the invasion of these worms it is likely to become stunted, and to require a great amount of food and care to place it in a condition to become a profitable stocksheep or feeder.

TREATMENT

The following quotations are taken from "Animal Parasites of Sheep" published by the Bureau of Animal Industry in 1890:

"Various remedies are proposed, but of those available an emulsion of milk and turpentine, prepared by shaking the mass well, seems most practicable. Add 1 part of spirits of turpentine to 16 parts of milk, and give from 2 to 4 ounces of it to each animal, according to the age of patient. One dose should be sufficient; if not, repeat it in three or four days. Or take of linseed oil one ounce, turpentine one-half ounce. Shake well and give as one dose. Quantities sufficient for any number of sheep may be made up in these proportions.

"Dr. H. J. Detmers, in a report to the Commissioner of Agriculture in 1883 on the diseases of sheep in Texas, recommends the use of tartar emetic as follows:—A half pound of tartar emetic is to be dissolved in 12 quarts of water, and from one to two ounces of the solution, containing from 5 to 10 grains of the remedy, is to be given each patient, depending on size. He recommends dosing out of a small 2-ounce vial, and in small swallows.

"The following recipe was recommended to the readers of the Field and Farm, August 7th, 1889, as a preventive for worms in sheep. Mr. G. B. Bothwell of Breckenridge, Mo., who used it for fifteen years with success is its author:—

"Salt, 1 bushel; air-slaked lime, 1 peck; sulphur, 1 gallon; pulverized rosin, 2 quarts; put in trough with cover where sheep can have free access. When sheep become thoroughly infested with worms death is sure to follow, but the above, if kept before the sheep, will surely act as a preventive."

The following was written by J. B. Bothwell of Mo. and is taken from Wallace's Farmer of Feb. 9, 1900.

"I took a bunch of lambs in September that were full of worms and gave each one-third of a teaspoonful of Santonine once a day for a week, or six doses, and in about three weeks repeated the dose for another week, and today, January 4, 1900, I could not find a lamb that showed a sign of a worm, and they are eating heartily and doing finely.

"It takes two men, or one man and a good spry boy to dose a lamb. Let the man stand the lamb on its feet between his knees, and with his right thumb

on top of the lower jaw and the left forefinger under the upper jaw, open the lamb's mouth, while the boy with an accurate eye and steady hand puts the Santonine on the root of its tongue; then let the jaws close and hold for a few seconds and it will get it all, and you will be astonished how quickly they can dose a hundred lambs. The Santonine actually kills the worms.

"I followed the Santonine with calomel at first, but did not like the effect and found by experimenting that it is not at all necessary. I buy the Santonine by the pound from my druggist and while it looks expensive the cost to each lamb is a mere pittance. It should be kept in the dark, as light destroys its strength. The lamb should run on the best of feed, but I believe it is a good plan to keep them up over night and dose in the morning on an empty stomach."

The following letter from a correspondent of the same journal appeared in the issue of March 2nd, 1900:

"I saw an article on stomach worms in lambs, from Mr. Bothwell, in your last issue. He recommends Santonine, given for six days and repeated in three weeks, which seems to be a good deal of labor. My experience with stomach worms in lambs seems less expensive and shorter. My flock of lambs, containing some sixty-four head, gave evidence of sickness in June and July. I bought two boxes of worm powder recommended to me, fed it mixed with salt, and gave it to them with a spoon, but the lambs commenced dying. Twenty head had succumbed when I saw gasoline prescribed in Wallace's Farmer. I mixed gasoline with two quarts of milk well emulsed and drenched the entire herd for three days, leaving them in the yard until late in the morning before treating them. Had weaned the lambs sometime previous and turned them in a corn field and meadow. Though several of them were so weak that they could scarcely walk, none died after this. About the first of February, after selecting sixteen of the best ewe lambs, the remainder were shipped to Chicago; twenty-five of them averaged 101 pounds and sold with the balance of the load for \$7.10, after four had been taken out and sold at \$5.50.

During the season of 1897 but little was done to check the disease in the flock of this Station until after they had been placed in winter quarters. We were then in possession of a lot of lambs that were fit subjects for experimentation. We began with the turpentine remedy given as recommended on a preceding page. After giving one dose time was given for improvement, but evidence of such improvement was wanting. At intervals of four and five days second and third doses were given. In some cases the remedy seemed to have done good work but positive evidence of it was not apparent. Certainly desired results were not reached in every case, as a number of these treated lambs died later on and upon examination of the fourth stomach strongyli were found, that must have been present when the turpentine was administered.

THE JULIEN BENZINE TREATMENT

One of the most recent methods used for combating the stomach worm is known as the benzine or gasoline treatment. This method was first described in *Annales Agronomiques* for November

and December, 1897, by M. Ch. Julien, Assistant Professor of the Agricultural School of Grignon, France, and was translated by this Station and placed before the flockmasters of the United States; first in an article published in the Breeders Gazette, Aug. 31, 1898, and later in a press bulletin, giving it general circulation in Ohio.

During the summer of 1898, beginning about the first of July, the flock of forty lambs, of five different breeds, belonging to this Station, began to die. They continued to drop off at intervals until about thirty percent of the flock had died. Post mortem examinations were held in almost every instance and there seemed to be no other cause for the trouble than the stomach worm. After allowing the trouble to continue for two months we began the Julien treatment, substituting gasoline for benzine, however, as a matter of convenience. At this stage of the trouble but few of the flock appeared healthy and some of them were quite thin in flesh; there was every indication that from one-third to one-half of the remainder of the flock would succumb to the disease. The gasoline seemed to check the trouble at once, as we did not have a single death after beginning the use of it. This treatment, as followed out in this instance, consisted simply in giving gasoline in flaxseed tea in the form of a drench. To describe more accurately: About one gallon of flaxseed, contained in a cheesecloth sack, securely tied, was placed over the fire in a kettle, containing at least two gallons of soft water, and allowed to steep for from one to two hours. The sack was then removed and allowed to drain out into the kettle while the tea was cooling. When the temperature was reduced to about that of freshly drawn milk we measured out into a bottle four ounces of the tea and poured into it, for each lamb weighing sixty to eighty pounds, one ordinary tablespoonful of common gasoline; then placing the thumb over the mouth of the bottle it was shaken vigorously for at least half a minute, after which it was poured quickly into a small sized drench bottle and at once given to the lamb. In giving this drench special care is required not to strangle the animal; *it should be set on its rump and held between the knees, using care not to throw the top of the head much further back than the line of the back of the sheep.*

It is not necessary to make the tea fresh for each treatment; it may be made in quantity, but should be warmed before adding the gasoline, as it will emulsify more readily and will possibly be a little more palatable as the warming makes it less adhesive. If too thick it may be reduced to the proper consistency by adding warm water.

Before giving the treatment we house the sheep in the evening and allow them to remain without anything to eat until ten o'clock of the day following; then the dose is given and the lambs are allowed to remain without food or water for three hours longer; we then let them drink and eat as they wish until evening. We repeat the same housing, fasting, dosing and feeding for two more days—

or three days in all. After a week has elapsed we repeat the three days' treatment, and if some or all of the flock do not improve repeat again ten days later.

At the suggestion of this Station Mr. J. E. Wing of Mechanicsburg, Ohio, began using this treatment in the season of 1898 and has since used it very extensively. Mr. Wing substituted gasoline for benzine, the gasoline being easier to obtain, and possibly even better for this purpose because it is more volatile. New milk may also be substituted for flaxseed tea. These two substitutions simplify the matter very much, because neither flaxseed nor benzine is common on every farm, but gasoline and sweet milk are nearly always to be had in these days of gasoline stoves and farm dairies.

Professor Julien states that one of the lambs treated by him died after receiving the second dose and upon examination he found many worms already dead, while others were in a continual state of agitation as if seeking to escape. Mr. H. P. Miller, Editor of the Sheep Department of the Ohio Farmer, writes as follows, under date of March 19th, 1900:

"I have examined the fourth stomach of three different sheep within one week after the last tablespoonful dose of gasoline, given on three successive days, and found live strongyli. I am fully satisfied, however, that although three doses will not remove all of them, sheep do improve under that treatment."

Mr. Miller makes a further observation which is quite interesting. He says:

"I had five lambs born during the latter part of September; they were allowed to run with a flock of ewes until in November. In January they were slaughtered. Every one of them was invaded by the stomach worm. *Not one of the lambs born since the ewes were confined in the stable has had them.*"

In our experience we have found, after giving the third dose, that a number of lambs passed worms which were identified in the droppings. From our experience with the flock of 1898 we had reason to believe that the above treatment had been the means of destroying the worms. During the late fall and winter months we gave similar treatment to some of our young sheep and to all older ones, without a single instance of bad effects, and I certainly believe that the treatment of the entire flock was a decided benefit to them.

AN EXPERIMENT TO PREVENT INFECTION

Early in the spring of 1899 the Station undertook to make an experiment looking toward the confirmation of the generally accepted theory that the lambs or young sheep take the disease through infection from the pasture. We had, by the 15th of April, 46 lambs—14 Dorsets, 12 Southdowns, 13 Shropshires, 6 Merinos and one Oxford. The latter was put with the Shropshire lot to make an even number. Each of the foregoing was then divided as nearly equally as possible, with the exception that the youngest

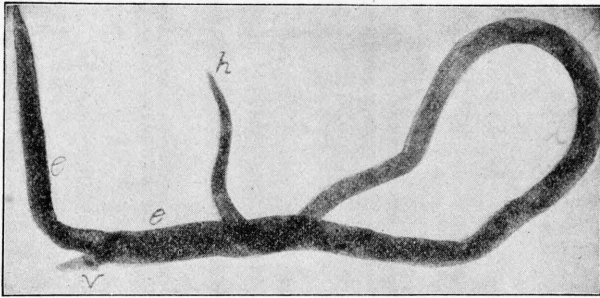


FIG. 1. *Strongylus contortus* (Rud.) enlarged about thirteen diameters.
h, head; *e*, *e*, egg sacks; *v*, vulva.

Original. From photo-micrograph by P. A. Hinman.

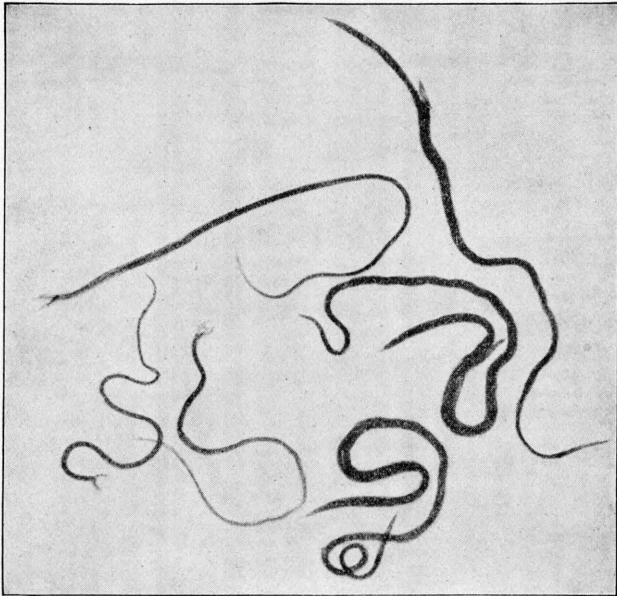


FIG. 2. *Strongylus contortus* (Rud.) enlarged about five diameters.
Three males and three females.

Original. From enlarged photograph by P. A. Hinman.

This page intentionally blank.

lambs were nearly all left in that division which was to go to the pasture with their dams, while the other half were kept in the fold from morning until evening, without access to their mothers. In the evening, between five and six o'clock, the entire flock was housed where one-half the lambs were kept through the day, and all remained there until about six to seven in the morning, when the ewes, with a part of the lambs, were taken again to the pasture. These lambs were practically all born between the 15th of March and the same date in April, and up to the latter date all ran with their dams upon pasture lands where sheep had run the year before. It was assumed that lambs so young would not eat grass and would therefore not become infected with the stomach worm. It should be distinctly understood that the lambs kept in (which lot will hereafter be designated as lot 1) were so kept constantly from the middle of April until the middle of September. They were fed some bran and oats mixed, also some hay, but got very little green feed of any kind until some time in July. As will be noted further on, they had no green feed until after both outside and inside divisions had been weaned. The inside lot is designated as Lot 1, the outside one as Lot 2.

In addition to the dry feed and hay, Lot 1 were given all the water they wanted, which was pumped from a driven well more than one hundred feet deep. Both lots were weaned July 1st, and both were kept in the sheep barn in separate apartments until August 1, when Lot 2 was again turned on pasture through the day but kept in at night. Within about a month after weaning 7 lambs died, out of 23 that had been running on pasture. An examination of three dead ones gave evidence of death from the stomach worm; the other four were not examined, but treatment with gasoline was begun at once; only, however, on the lot that had been on pasture. Two weeks later the three-day treatment was repeated, and since then we have not lost a single lamb from this lot.

Lot 1 was kept in until about the middle of September, when they were turned out for their first pasturing on a patch of rape and the other lot was put in with them, that the two lots might have the same pasture, the same chance at the feed trough and the same surroundings.

In Lot 1 not a death has occurred up to this writing; two of the 23, however, have not done well from the first, but they were twin lambs, fed from a bottle and always small, weak lambs.

COMPARISON OF COST BETWEEN LAMBS RUNNING OUT AND THOSE KEPT IN

The single experiment on prevention detailed above is not sufficient proof to justify positive conclusions. The question of comparative cost is also an item of no little importance. Lots 1 and 2 were separated every morning and fed a grain ration composed of oats and wheat bran; a careful record was kept, which shows the following: Lot 1 ate of this mixture in May 170 pounds; in June 310 pounds; in July 393 pounds; in August 518 pounds and during

the first 19 days of September 470 pounds, or a total of 1861 pounds. Lot 2 ate during the same months, in May 159 pounds; in June 310 pounds; in August 373 pounds and during the 19 days of September 292 pounds or a total of 1520 pounds.

Both lots had before them dry hay every day, up to July 21st, and Lot 1 ate up to this time 372 pounds and Lot 2, 199 pounds. After July 21st Lot 1 was fed on Canada peas and oats, cut green, and later on second crop clover until September 20. No account was kept of the weight of this green feed, for Lot 2 had similar feed and was running on pasture after the first of August, both lots being placed together and on the same feed after the 20th of September. I have regarded the grass and green feed eaten by Lot 2 as equal to the green food consumed by Lot 1. From the figures given above it will be found that Lot 1 ate 341 pounds more grain and 173 pounds more hay than Lot 2. With bran at \$15 per ton, oats at 25 cents per bushel, and hay at \$8 per ton we find that Lot 1 has cost us for feed up to the 20th of September, 14 1-3 cents a head more than Lot 2. But Lot 2 is reduced 7 head, or about 30 percent, in numbers. Figuring upon the basis of lambs in each lot on September 15th, we find that Lot 1 must be charged with 81 pounds of grain and in round numbers 12 pounds of hay each; while Lot 2 must be charged with 108½ pounds of grain each and 14 pounds of hay; a charge of 65 cents apiece against Lot 1 and of 91 cents a head against Lot 2. On this basis Lot 2 has cost us 26 cents per head more than Lot 1. Furthermore, Lot 2 must continue to have treatment and good care, while Lot 1 if put upon fresh pasture would possibly take care of themselves.

Without previous experience in such treatment of lambs the impression would naturally follow that lambs kept from their mothers all day and without green feed would not do well; but a careful study of the tables of monthly weights of these lambs, given on a subsequent page, will show that they have done almost as well as those given more freedom and allowed to suck at pleasure.

Table I gives individual weights for each thirty days up to September 1st, then weights for fifteen days, because the lambs were soon after that date fed alike and pastured as one flock.

Turning to Table 2 and comparing Dorset Lots 1 and 2, consisting of six individuals each, we find that those kept in started 15 pounds behind and came out, September 15, 135 days later, 32 pounds behind, or gained 17 pounds less than the same number running out; an average of nearly 3 pounds per head less.

The Shropshire lots were made up of five each. Lot 1 started with a total weight of 19 pounds greater than that of Lot 2, and came out at the close of 135 days 6 pounds behind that lot, a total gain of 25 pounds less than that of Lot 2, or an average of 5 pounds apiece.

The Southdown lot inside (Lot 1) started 19 pounds ahead, and came out 9 pounds ahead, or a gain of 10 pounds less than that of Lot 2, or about three and one-third pounds apiece less gain.

The Merino lot inside started with 22 pounds greater live weight and came through with 9 pounds more than the outside lot, a total loss of 13 pounds, or an average of four pounds and one-third less gain than that of the outside lot.

It is but fair to mention in this connection that the wide difference in the Shropshire lot was due, in part at least, to the small gains made by number 338, which was one of the twin lambs spoken of elsewhere as being fed by bottle.

METHOD OF ADMINISTERING GASOLINE

Since some have experienced serious difficulty in administering the gasoline it is thought best to lay special emphasis on this feature. Frederick Summer, V. S. in an article published in the *Indiana Farmer* of October 14th, 1899, calls attention to difficulties he has experienced and also speaks of similar disastrous results following like treatment given by J. Wooton, of Downers Grove, Ill. Prof. Walter J. Quick of Brooklyn, Ind., in a letter to the *Indiana Farmer* of March 10, 1900, touches upon some points of special interest in this connection. Prof. Quick speaks first of having noticed an article in the *Indiana Farmer* of November 18, last, giving careful and detailed directions for administering gasoline to lambs and sheep affected with worms and demonstrating conclusively that skilled manipulators and professional men were not necessary to the successful giving of gasoline, but that unskilled persons could give it. He then says:

"On our lower farm we had a few cars of feeding lambs. We were losing one occasionally; a study of the cases and conditions convinced us that it was intestinal parasites which worm powders had not reached. We concluded to try the gasoline, but first determined to hear more particularly from our colleague and friend of several years' standing, Prof. Hickman. His personal letter kindly went further into detailed explanation and suggested that they had found milk quite as good and less trouble than flaxseed tea, in which we agree with him heartily. But one important point was not urged or dwelt upon by our friend and in this we opine lies the difference of results and reports. Directions should always be studied and followed to the letter. A deviation may, and often does cause loss and disagreement, as is the case in the use of this treatment. If as valuable as its users seem to think and indicate, the difference in opinion and results should be determined and removed. Having had our experience and paid for it, we are willing to relate it for the benefit of others needing the treatment in their flocks.

"Having the article mentioned, also letter of directions from Prof. Hickman, we commenced. The worst cases were a lot of grade lambs on the lower place that we were feeding in the Bethany Park stables. We followed directions carefully as we thought, even measuring the milk, just 4 ounces, and gasoline, 2 drams, in a graduate, until we found and marked a tin cup for the milk and secured a tablespoon that held just 2 drams. We personally prepared every dose in small drench bottles and careful men did the drenching. We first tried a few, then waited, then 8 or 10 more, and seeing no ill effects in an hour went

to work in earnest with two sets of men, as we desired to dose about 400 that afternoon. We did, and soon after finishing commenced turning out to water and fodder; at least the two hours' time recommended had passed since administering to the first. We found one of them down; it soon died. As they commenced to move others staggered and fell; some reared and fell, dying in less than a minute (we will explain this further.) This continued until 17 died. We all believed the number would have reached fifty had we not had convenient several gallons of milk and cream which we as rapidly as possible gave those most affected, giving evident and immediate relief.

"Now we have known and heard of guns going off half cocked and without being loaded. We did not want to do anything of that sort, nor could we think of repeating the operation. We could but decide that something was wrong in our treatment and also that causing loss to Veterinarian Summer and others. We searched for something in Prof. Hickman's article of November 18th that we had omitted to observe. The only difference we could find was in the position the sheep were held for drenching. After an experience from childhood in the drenching of numerous horses and cattle, and still larger numbers of sheep, and never having drenched, or seen any drenched, any way but on their feet, 'on all fours,' unless the animal was too sick to stand, we naturally drenched that way. We failed even to observe that Prof. Hickman said: "One of our farm hands caught the sheep and set each one on his rump while a third man poured the dose of flaxseed tea and gasoline down as a drench." We wrote Prof. Hickman relating our experiences and loss and giving our opinion of the cause of our unsatisfactory results. Before we got his reply, some that we had not drenched were evidently in a critical condition and we knew their days were numbered any way, hence we commenced on them, setting them up, but otherwise administering as before. We found that all went well. We proceeded to administer to 100 and there being not a death, repeated three days in succession—300 doses—without a death. Since then came Prof. Hickman's answer regarding the question we raised as to whether the position in which the sheep are held for drenching does not explain the cause of the great mortality experienced by so many."

In substance the reply to the above was that I instinctively, in catching a sheep for any purpose whatever, catch and set him on his rump. You will observe that a sheep man does this if he wants to shear the sheep, if he wants simply to clip his hoofs, if he wants to give him medicine, and certainly at all times when he wants to prevent struggling by the sheep. I have never attempted to give either gasoline treatment or any other medicine, without first setting him up, and I think I can readily see how the difficulty would naturally arise in attempting to give him medicine in any other way, and this is especially true with the gasoline treatment. The object, of course, in setting him up is that it may run as quickly as possible to the stomach. By this method we naturally relieve the throat in the quickest possible manner and avoid strangulation. Again quoting from Prof. Quick's article, he says:

It would seem that sheep, as well as cattle and horses, could be drenched on 'all fours.' But we have paid to be, and are convinced, that it cannot be done in administering gasoline. Try it on yourself. That is, take a glass of water and, holding your head back as a sheep's must be when drenched on its feet, take a drink. You will be almost sure to get water into your windpipe and strangle. We learned from Dr. Bitting, at our recent State Wool Growers'

Meeting, that hundreds of flocks in Indiana, as well as in other states, are sorely afflicted with intestinal parasites and the twisted stomach worm. He, and also Dr. Alexander of the Breeder's Gazette, says that the gasoline treatment cannot be administered with safety except with a rubber stomach tube and a funnel. We are glad to say we have learned that it can, and have returned to the feeding lambs for a complete going over with but one loss, probably from gasoline entering the windpipe while the lamb was struggling."

To the above I wish to add that at this Station we have given more than one thousand doses with the drench bottle and have lost but a single sheep, while another farmer has reported the giving of two thousand doses without a single loss. The cost of the medicine is exceedingly small and the time for drenching each sheep need not exceed one minute when three persons do the work, or an equivalent of three minutes for one man.

THE EFFECT OF GASOLINE TREATMENT

In two or three instances breeders have reported that it was their opinion that a lamb given this gasoline treatment would suffer from impaired digestion for months afterward. To demonstrate whether such an opinion is well founded or not, I have compiled, in Table 1, the live weights of both lots of lambs at the end of every thirty days from April 30th up to the 28th of February, the last monthly weighing.

TABLE I.—MONTHLY WEIGHTS OF LAMBS UNDER EXPERIMENTS: LOT I

Breed and Number	Apr. 30	May 30	June 30	July 30	Aug. 30	Sept. 15	Sept. 30	Oct. 30	Nov. 30	Dec. 30	Jan. 30	Feb. 28
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Dorset, 302.....	25	30	39	43	52	57	58	68	76	77	85	94
" 304.....	25	35	44	45	55	58	62	74	84	89	77	103
" 305.....	17	31	40	43	51	61	61	74	81	76	93	100
" 307.....	25	37	39	40	48	54	55	67	72	72	84	96
" 308.....	26	38	49	51	60	65	71	82	96	99	107	120
" 309.....	20	28	34	35	41	47	46	56	62	64	62	79
Shropshire, 333.....	22	37	48	48	54	62	63	69	83	77	93	102
" 336.....	22	34	34	32	38	43	45	46	53	50	57	65
" 338.....	16	27	27	24	26	30	29	31	33	34	37	45
" 339.....	22	34	43	42	48	53	53	57	67	78	79	82
" 340.....	20	27	31	30	37	40	41	46	55	55	61	67
Southdown, 315.....	21	32	38	38	41	46	48	54	67	65	81	92
" 317.....	26	37	46	47	52	56	57	62	71	71	81	87
" 322.....	19	32	37	39	45	49	47	56	65	59	67	76
Merino, 327.....	22	31	38	34	40	42	44	52	61	65	77	83
" 328.....	25	36	46	43	49	52	55	67	83	80	96	104
" 331.....	17	25	30	30	34	38	41	52	57	63	63	80

TABLE I—MONTHLY WEIGHTS OF LAMBS UNDER EXPERIMENTS: LOT II

Breed and Number	Apr. 30 Lbs.	May 30 Lbs.	June 30 Lbs.	July 30 Lbs.	Aug. 30 Lbs.	Sept. 15 Lbs.	Sept. 30 Lbs.	Oct. 30 Lbs.	Nov. 30 Lbs.	Dec. 30 Lbs.	Jan. 30 Lbs.	Feb. 28 Lbs.
Dorset, 301.....	31	46	58	57	61	67	69	78	87	80	88	94
" 303.....	27	36	51	53	62	63	67	74	79	76	88	98
" 306.....	31	46	64	60	69	74	81	93	101	99	106	115
" 311.....	29	44	62	57	66	68	71	81	89	81	96	102
" 313.....	20	33	43	39	47	53	54	63	71	68	76	83
" 314.....	15	27	41	38	45	49	53	58	69	66	68	63
Shropshire, 334.....	18	25	35	38	46	48	53	61	68	69	78	84
" 335.....	14	23	35	32	40	48	48	56	65	64	61	76
" 337.....	22	33	48	47	50	54	56	61	70	68	76	83
" 341.....	17	28	33	33	37	40	41	49	55	54	58	63
" 342.....	12	23	32	33	41	44	45	53	61	66	78	89
Southdown, 316.....	18	32	46	43	54	57	61	65	71	68	78	86
" 321.....	10	19	29	28	34	38	40	47	56	52	58	64
" 326.....	19	31	41	43	40	47	51	57	64	64	61	77
Merino, 329.....	14	25	25	34	40	44	47	56	61	63	75	82
" 330.....	14	25	37	31	38	41	42	44	48	52	60	62
" 332.....	14	20	31	27	35	38	36	44	49	51	62	66

TABLE II—TOTAL MONTHLY WEIGHTS OF LOTS I AND II

Breed and Lot	Apr. Lbs.	May Lbs.	June Lbs.	July Lbs.	Aug. Lbs.	Sept. 15 Lbs.	Sept. 30 Lbs.	Oct. Lbs.	Nov. Lbs.	Dec. Lbs.	Jan. Lbs.	Feb. Lbs.
Dorset, Lot I.....	138	199	245	257	307	342	353	421	471	477	508	592
" Lot II.....	153	232	319	304	350	374	395	448	496	470	522	555
Difference.....	-15	-33	-74	-47	-43	-32	-42	-27	-25	7	-14	37
Shropshire, Lot I.....	102	159	183	176	203	228	231	249	291	294	327	361
" Lot II.....	83	132	183	183	214	234	243	280	319	321	351	395
Difference.....	19	27	00	-7	-11	-6	-12	-31	-28	-27	-24	-34
Southdown, Lot I.....	66	101	121	124	138	151	152	172	203	195	229	255
" Lot II.....	47	82	116	114	128	142	152	169	191	184	197	227
Difference.....	19	19	5	10	10	9	00	3	12	11	32	28
Merino, Lot I.....	64	92	114	107	123	132	140	171	201	208	236	267
" Lot II.....	42	70	93	92	113	123	125	144	158	166	197	210
Difference.....	22	22	21	15	10	9	15	27	43	42	39	57

Referring to Table I, we find that nearly every lamb made substantial increase in weight during the month of August. It was during that month that all the lambs in Lot 2 were treated, each lamb receiving six doses of gasoline. It may be further noted that these lambs have made good gains each month since, as they have been given only stock care. We find that the average weight of these treated lambs at about eleven months of age is as follows: Dorsets, 92½ pounds; Shropshires, 79 pounds; Southdowns, 75⅔; Merinos, 70 pounds each. On the other hand, we find that the average weights of Lot 1 of the several breeds at the last weighing was as follows: Dorsets, 98⅔ pounds; Shropshires, 72½ pounds; Southdowns 85 pounds and Merinos 89 pounds. This certainly makes a good showing for lambs kept from grass and fed on dry feed. When the fact is taken into consideration that Lot 2 has passed through a period of infection with stomach worm and treatment for same, the growth they have since made is an indication that their digestive systems have not suffered permanently either from the infection or from the treatment.

The weights of all lambs in the experiment are not given, for the reason that fair comparisons could only be made with equal numbers of each breed. It has therefore been thought best to drop out one from Lot 1 for each one that died in Lot 2. In dropping out it has been the aim to drop out lambs of average size, in no case selecting the poorest or the best.

LABOR REQUIRED WHERE LAMBS ARE HOUSED CONTINUOUSLY

The labor involved in keeping lambs from grass is perhaps one of the greatest obstacles to this method of prevention. When the ewes are pastured near the sheep house the extra time required is very trifling until the lambs are weaned, when more time and attention will be necessary. If the lambs are fed in a separate apartment while small, and a hole is made for them to get into it such as the mother cannot get through, the matter of daily separation is reduced to a minimum. After the first new lambs are trained to go to the separate feeding apartment those coming later will very soon learn the way. After the first two or three days the mothers will leave the young and go to the pasture without trouble, and when evening comes they will return to the fold without much driving, especially if they are given a little grain feed each night when brought up.

The period of stabling could be very much shortened by planting a small field of rape, which should be ready for pasturing by the middle of July, or possibly two weeks earlier. Again, most farmers in the sheep growing regions have second crop clover large enough to pasture by the middle of July; but even in this case the rape would be especially handy to have, for dry weather may keep back the clover.

Pasture of any kind where sheep have not pastured since plowing would be regarded free from these parasites.

SUMMARY

Meteorological conditions are not wholly responsible for the appearance of the stomach worms, though wet seasons and low wet pastures may aid their development.

Good authorities claim that infection comes through grass taken from pastures where sheep have fed and dunged, and that the egg is there left in the manure and taken in while the host is pasturing. The experiment detailed in this bulletin confirms that opinion.

Characteristic symptoms are hardly to be separated from conditions due to similar trouble caused by other parasites of the lungs and alimentary canal.

Benzine, when given with care, is one of the best remedies known and from the evidence thus far gathered, reaches and destroys the parasite.

Gasoline is quite as good for the purpose as benzine, and sweet milk may be substituted for flaxseed tea.

One tablespoonful of gasoline and four ounces of sweet milk well shaken together, is a good dose for sheep weighing anywhere from 60 to 100 pounds. The quantity of milk may be reduced or increased slightly without detrimental results.

Each sheep or lamb should be set on his rump and so held that he will not struggle, while the dose is given as a drench, and his head should not be thrown farther back than the natural position while standing.

Treatment should never be given on full stomach, but only after 12 to 18 hours fasting, and neither water nor feed should be given inside of two hours after giving the medicine.

Treatment should be given three days consecutively, then repeated one week or ten days later for the same number of days.

The monthly gains made by our lambs, after giving gasoline in the recent experiment, together with other evidence, indicate that no practical injury has been done to the digestive system nor to the general constitution of the animal.

This single experiment indicates that lambs kept from pasture will not suffer from this parasite, and may be made the equal in size and constitution of lambs running with mothers all the time.

This page intentionally blank.